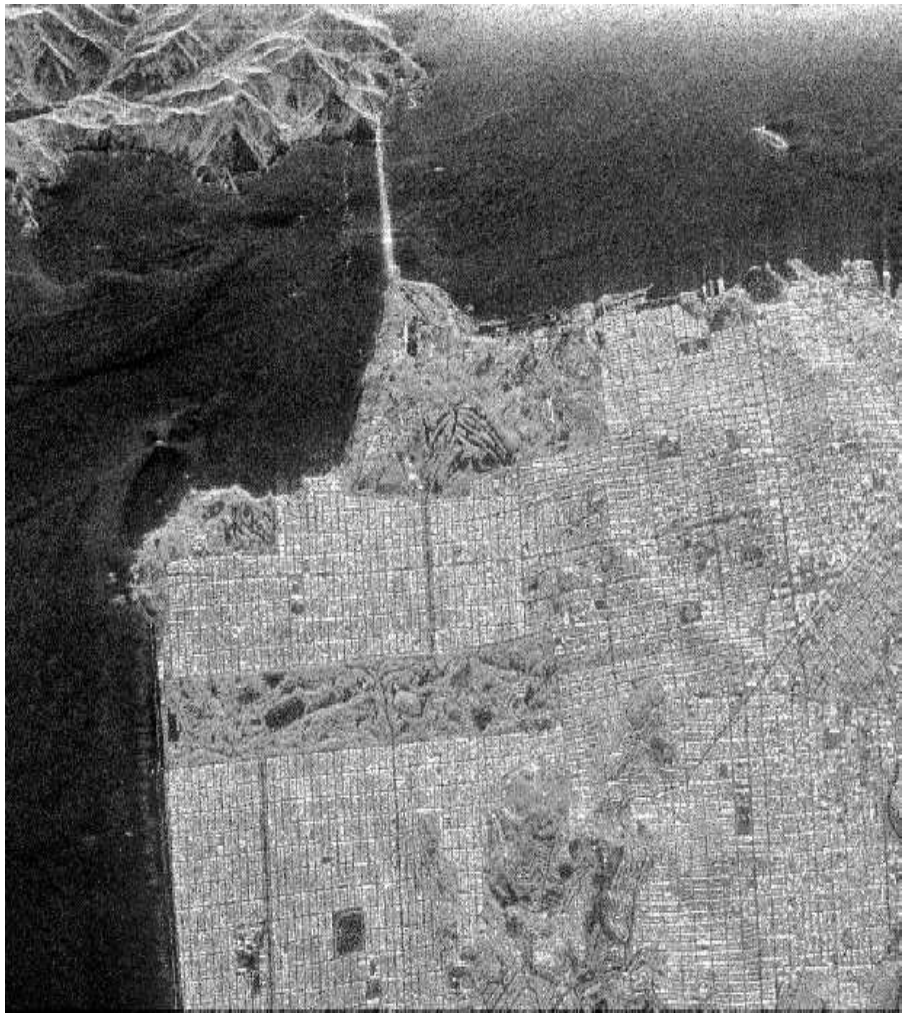
SAN FRANCISCO BAY

L-band 1988

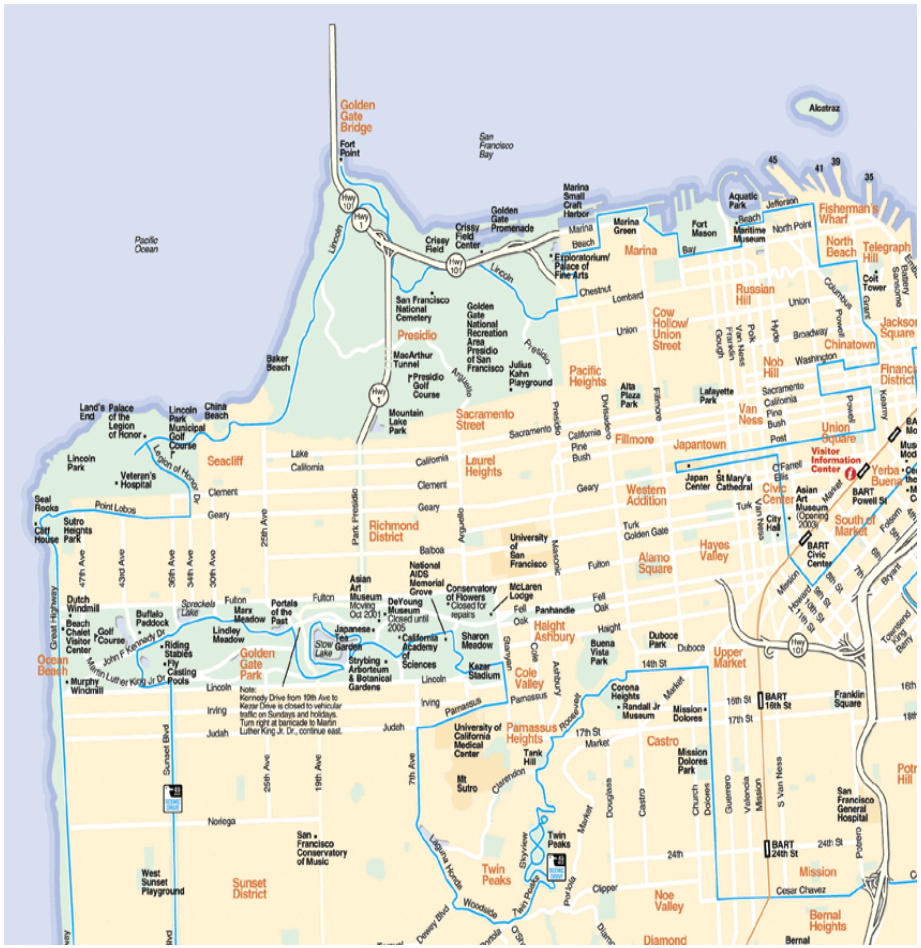
AIRSAR JPL

DC8

P, L, C-Band (Quad)



TARGET GENERATORS



|HH+VV| **|HV |** **|HH-VV|**

$T_{11}=2A_0$ $T_{33}=B_0-B$ $T_{22}=B_0+B$

TARGET GENERATORS

Sinclair Color Coding

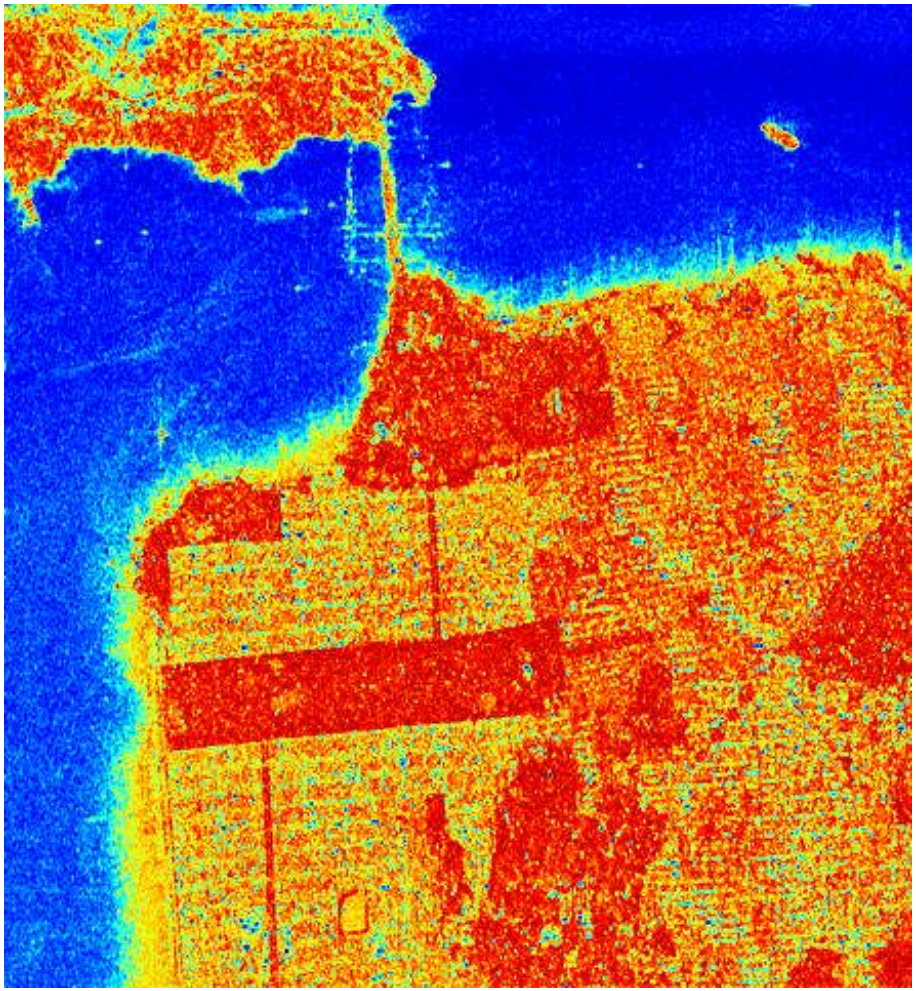
|HH| |HV | |VV|

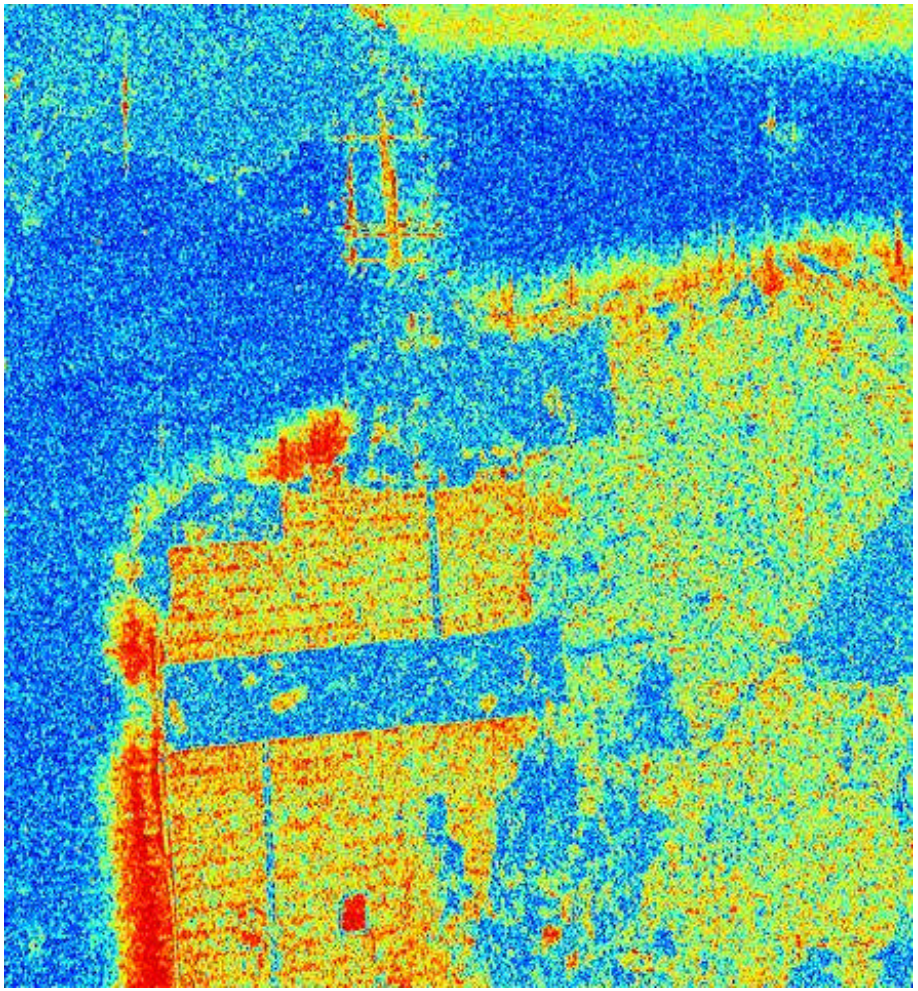
Pauli Color Coding

|HH+VV| |HV | |HH-VV|

$T_{11}=2A_0$ $T_{33}=B_0-B$ $T_{22}=B_0+B$

H / A / α DECOMPOSITION

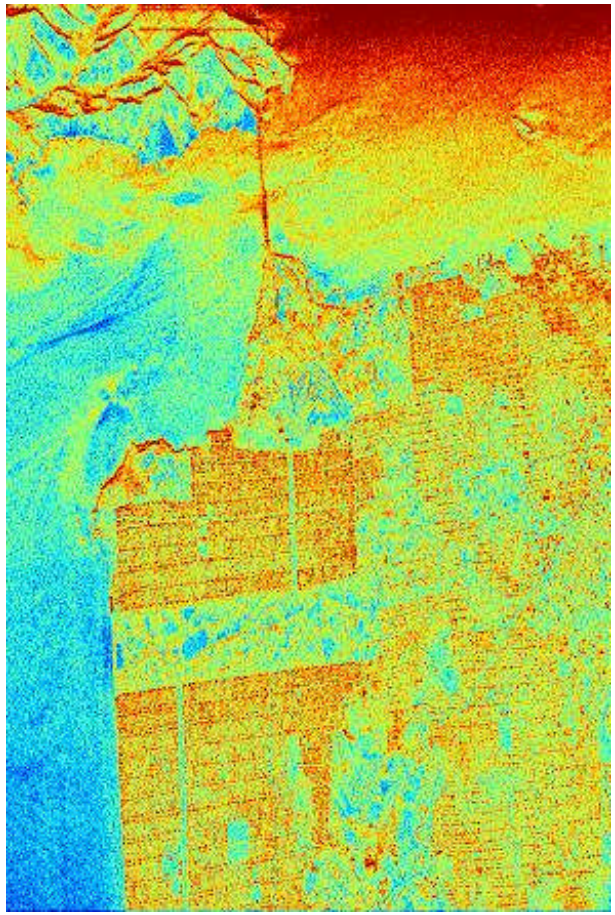




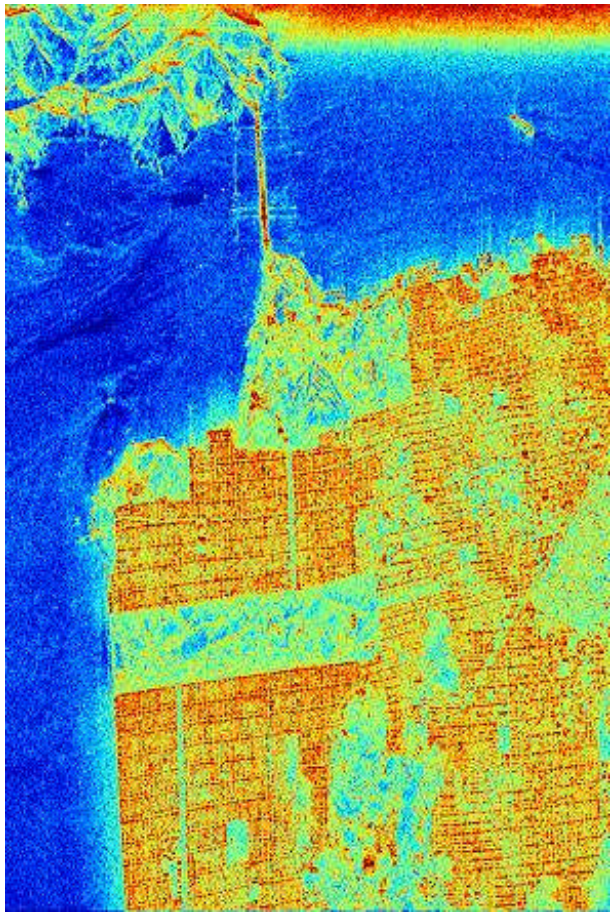
ENTROPY (H)

ANISOTROPY (A)

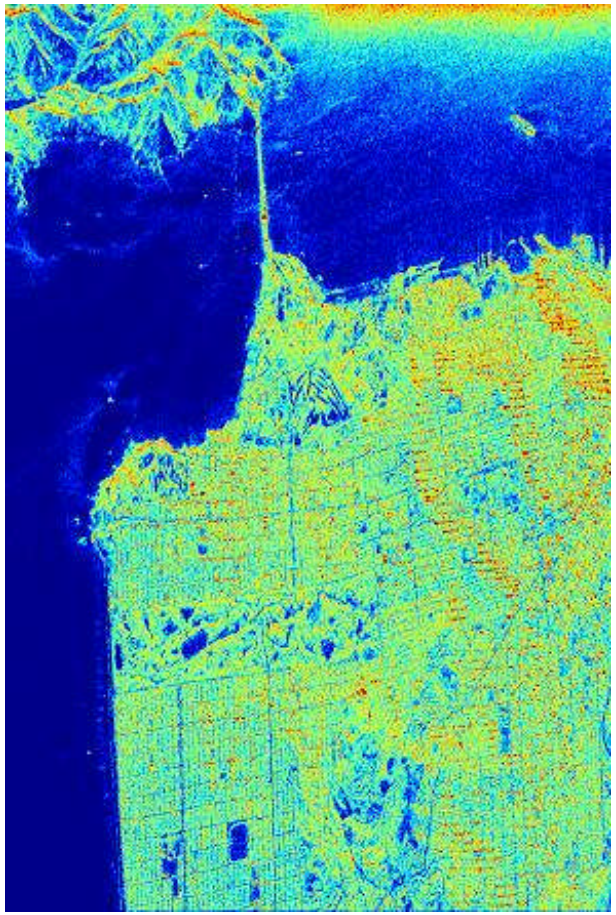
TARGET GENERATORS



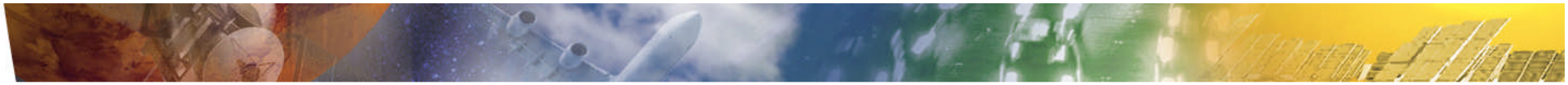
$(2A_0)_{dB}$



$(B_0 + B)_{dB}$



$(B_0 - B)_{dB}$



IGARSS 2006

Denver, Cororado, 2006

Polarimetric Analysis of Radar Signature of a Manmade Structure

J.S. Lee, T. Ainsworth

NRL, Washington DC 20375, USA

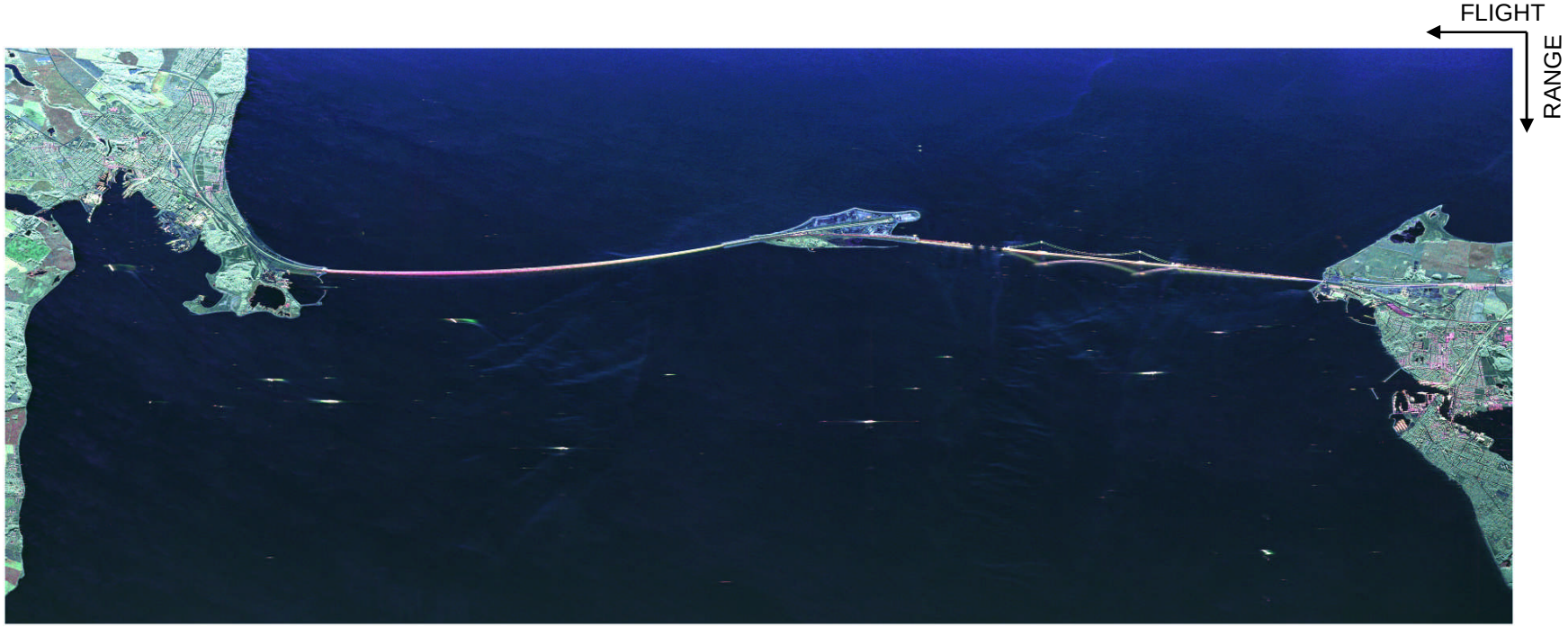
Ernst Krogager

Danish Defence Research Establishment, Copenhagen, Denmark

Wolfgang-Martin Boerner

University of Illinois at Chicago, IL, USA

Polarimetric SAR Image

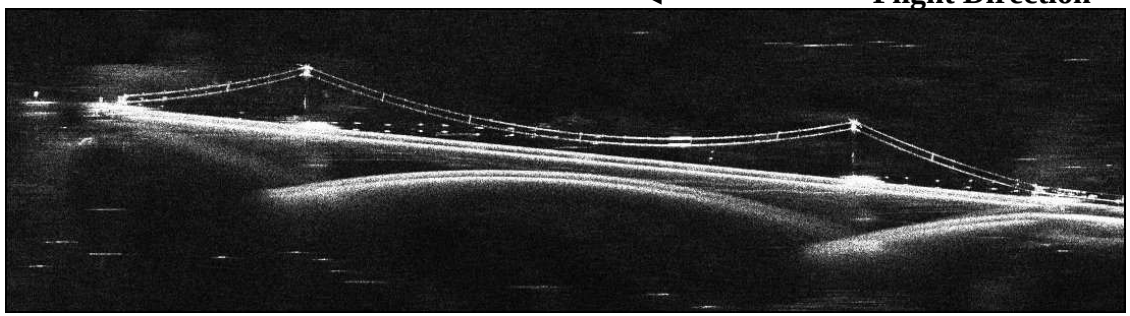


Pauli Vector, |HH-VV|, |HV|, |HH+VV|

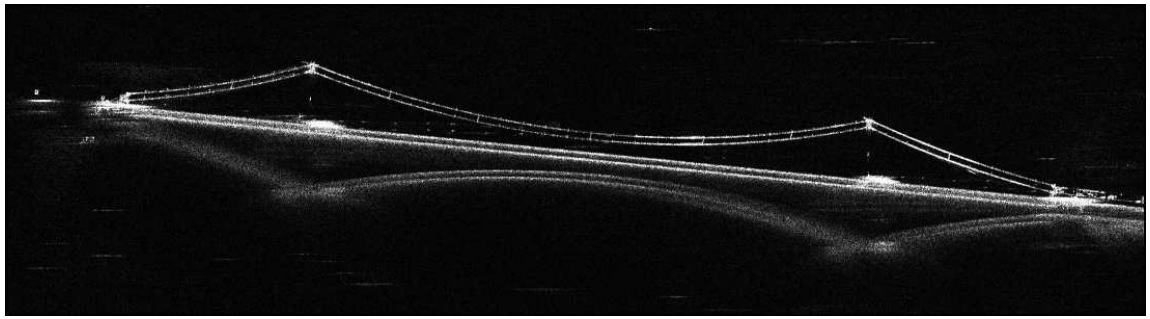
EMISAR C-Band Polarimetric SAR Image of StoreBelt Bridge

Store Bridge Signature during Construction

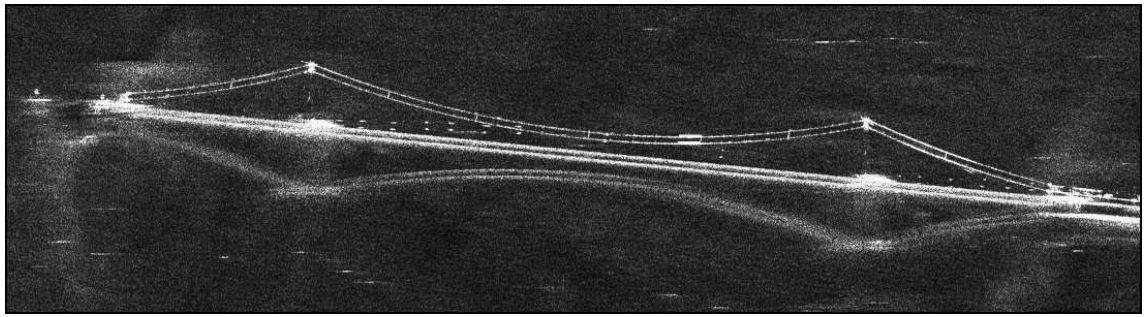
Flight Direction



|HH|

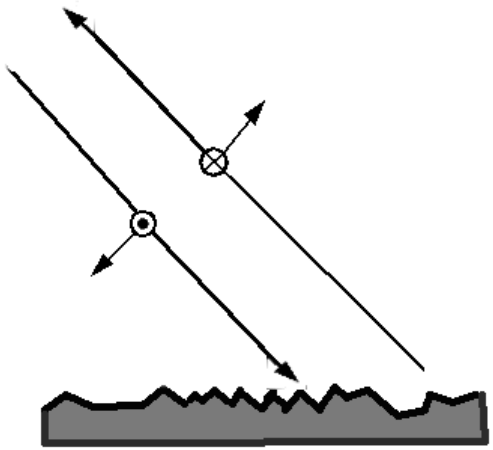


|HV|



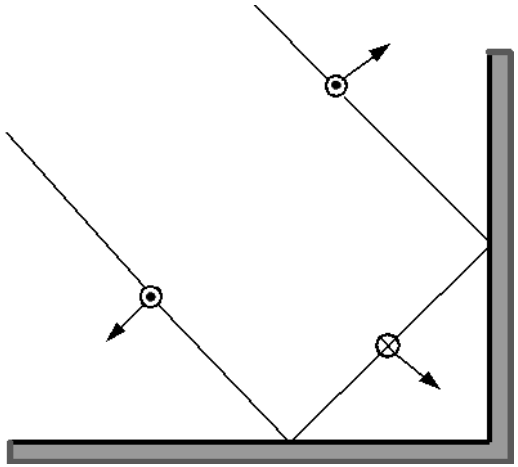
|VV|

Surface and Double Bounce Scatterings



Surface (Bragg) scattering
HH and VV are in phase

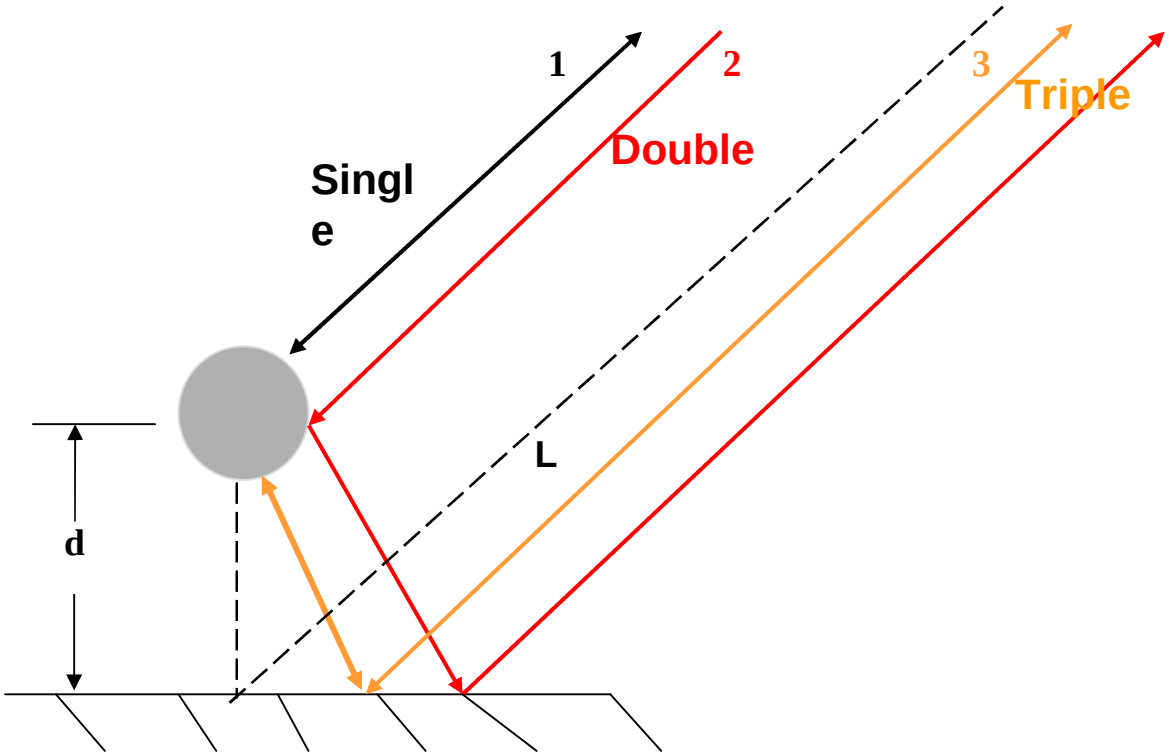
Realiter, phase difference of Bragg scattering, albeit small, is a function of incidence angle & dielectric constant.



Dihedral scattering
HH and VV is 180° out of phase

Two perpendicular conducting plates

Multi- Bounce Scattering



Roundtrip distances:

Single bounce return: $2(L - d\cos\theta)$

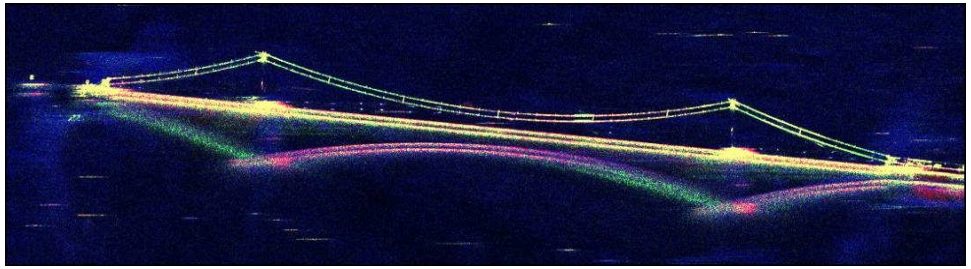
Double bounce return: $2L$

Triple bounce return: $2(L + d\cos\theta)$

θ is the local incidence angle.

Polarimetric Target Decomposition

Pauli Decomposition, |HH-VV|, |HV|, |HH+VV|

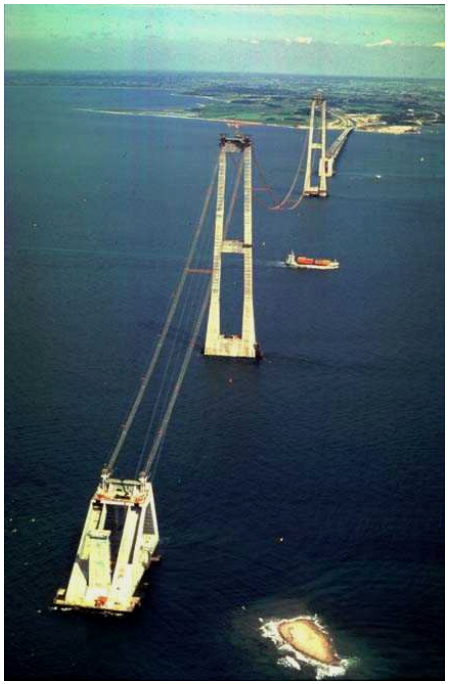


Krogager SDH Decomposition

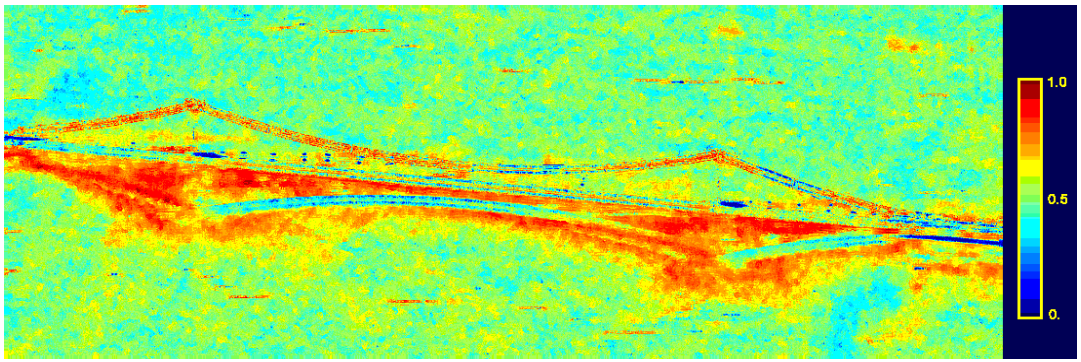
- Blue= Sphere Green = Helix Red = Diplane.

EMISAR C-Band Polarimetric SAR Image of StoreBelt Bridge

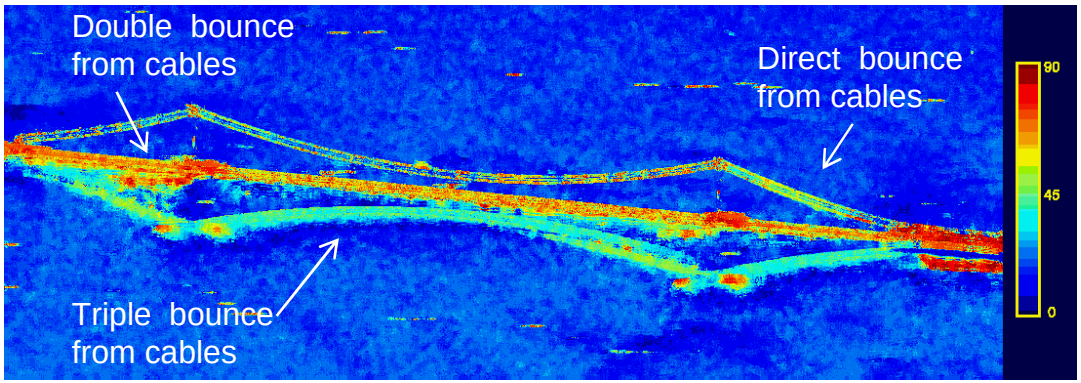
Cloude and Pottier Decomposition



Bridge under construction - deck not installed.



H
Entropy



α
Alpha
Angle
(Rotational
invariant)

Dominant scattering mechanisms are extracted by applying target decomposition:

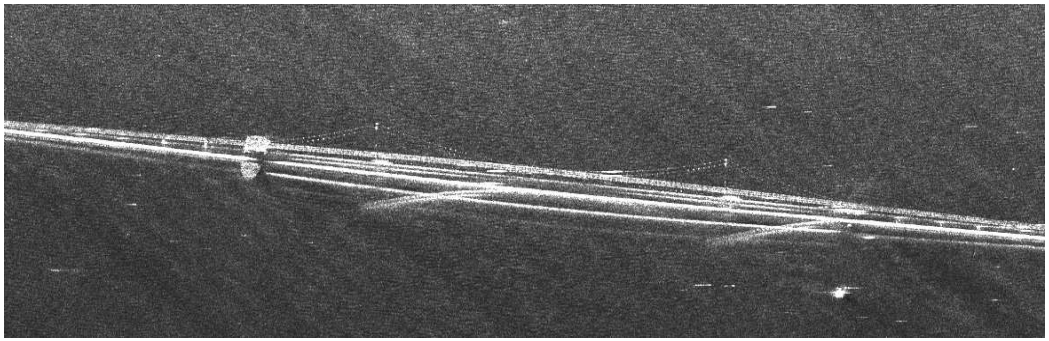
Blue= Surface Green = Dipole Red = Double Bounce.

EMISAR C-Band Polarimetric SAR Image of StoreBelt Bridge

BRIDGE RADAR SIGNATURES

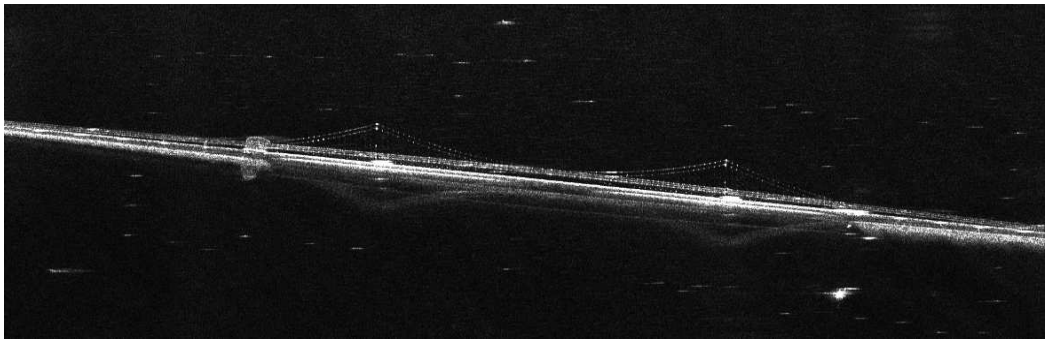
After Completion of Bridge Construction

|HH+VV|



|HH-VV|

|HV|

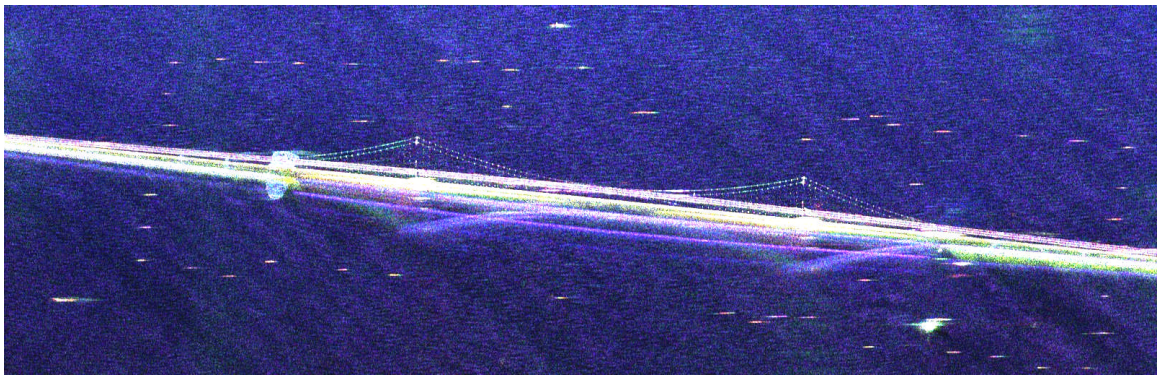


(EMISAR C- Band)

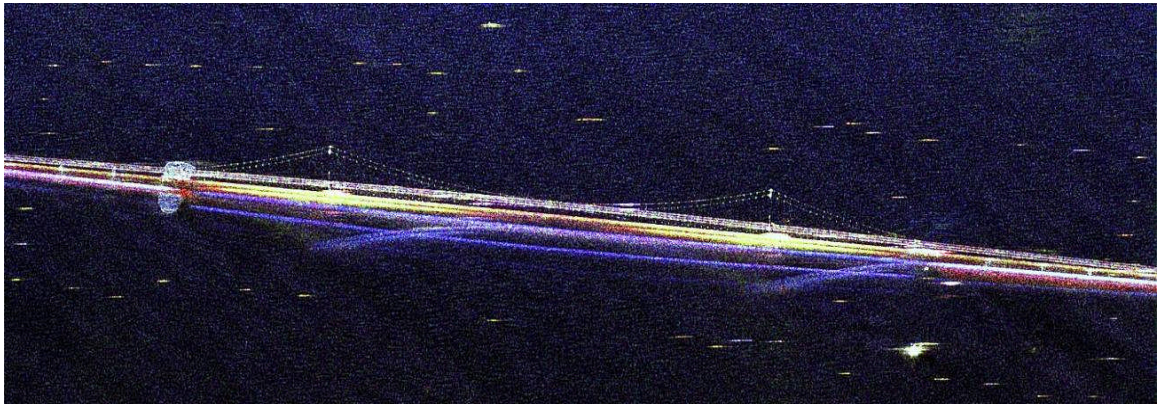
Polarimetric Target Decomposition – After Completion

FLIGHT

RANGE

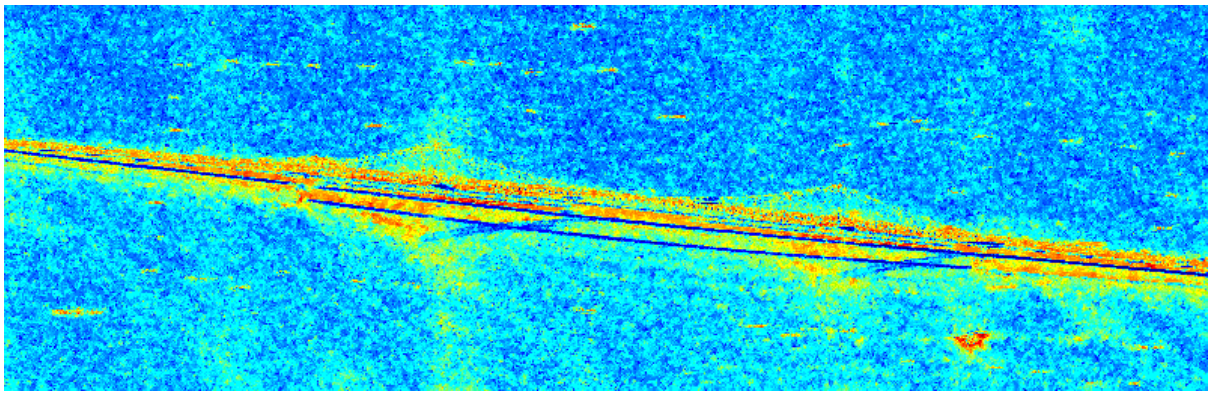


|HV|
|HH-VV|
|HH+VV|

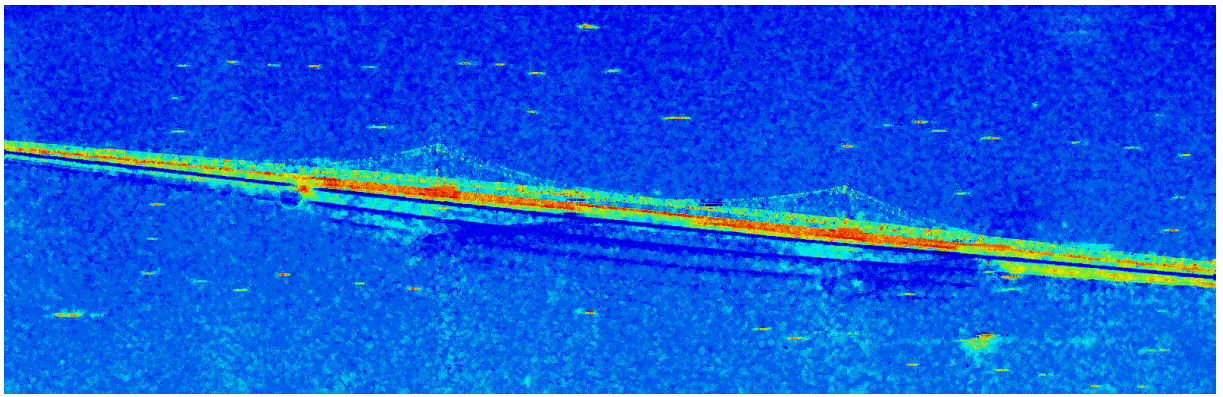


SDH

Cloude and Pottier Decomposition – After Completion



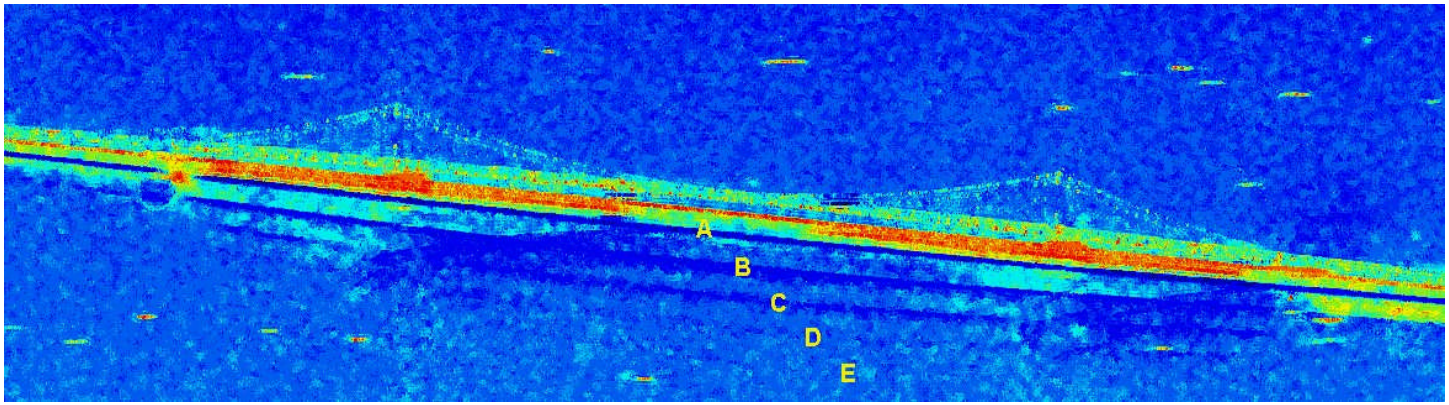
Entropy



Angle α

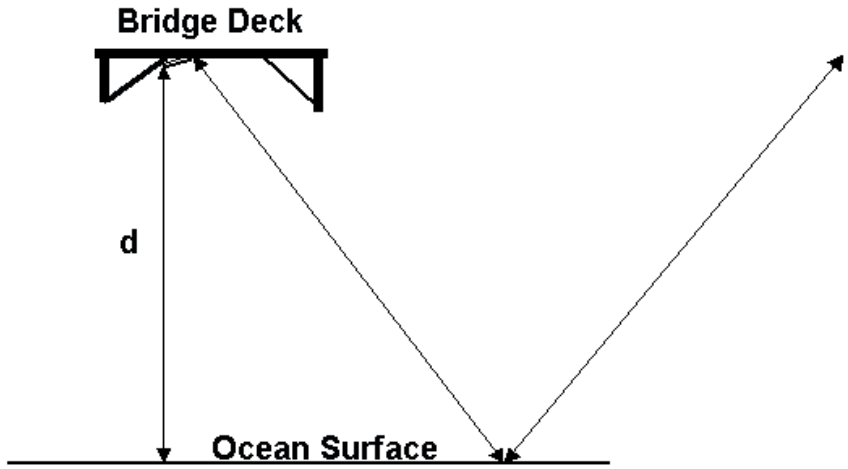
Dominant scattering mechanisms are extracted by applying target decomposition:
Blue= Surface, Green = Dipole, Red = Double Bounce.

Higher Order Multiple Bounces – After Completion



α
Alpha

6c



7

Roundtrip distances:

A: Triple bounces, $2(L + d\cos\theta)$

B: 5 (or 7) bounces, $2(L + d\cos\theta) + 2d$

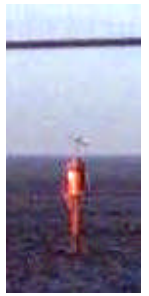
C: 7 (or 9) bounces, $2(L + d\cos\theta) + 4d$

D: 9 (or 11) bounces, $2(L + d\cos\theta) + 6d$

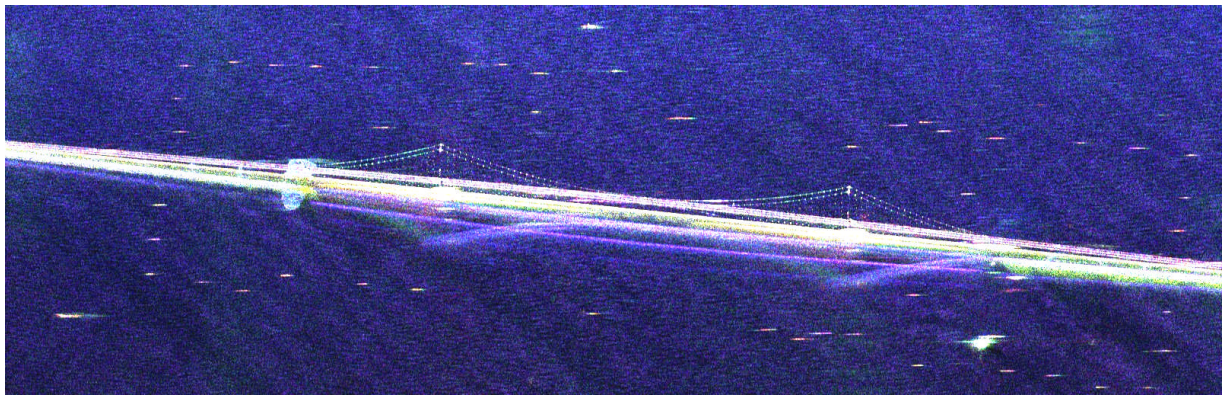
(…) indicates additional two bounces from the bottom of the deck.

Dominant scattering mechanisms are extracted by applying target decomposition:
Blue= Surface Green = Dipole Red = Double Bounce.

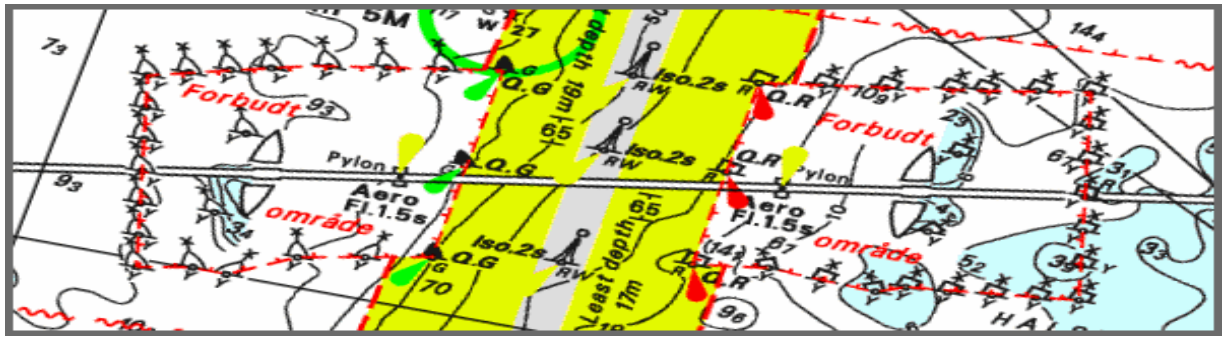
BRIDGE AND BUOY RADAR SIGNATURES



(EMISAR C- Band)



Polarimetric SAR Image (|HH-VV|, |HV|, |HH+VV|)



Navigation Map of Storebelt, Denmark